

U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF SOILS—MILTON WHITNEY, Chief.

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SOIL SURVEY OF EASTLAND COUNTY,  
TEXAS.

BY

WILLIAM G. SMITH, IN CHARGE, J. H. AGEE,  
W. I. WATKINS, AND W. A. ROCKIE.

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HUGH H. BENNETT, INSPECTOR, SOUTHERN DIVISION.

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## LETTER OF TRANSMITTAL

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF SOILS,  
*Washington, D. C., April 28, 1917.*

SIR: In the extension of the soil survey in the State of Texas, work was undertaken in Eastland County and completed during the field season of 1916.

The accompanying report and map cover this survey, and are submitted for publication as advance sheets of Field Operations of the Bureau of Soils for 1916, as authorized by law.

Respectfully,

MILTON WHITNEY,  
*Chief of Bureau.*

Wm. D. F. HOUSTON,  
*Secretary of Agriculture.*

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### MAP.

Soil map, Eastland County sheet, Texas.



## SOIL SURVEY OF EASTLAND COUNTY, TEXAS.

By WILLIAM G. SMITH, In Charge, J. H. AGEE, W. I. WATKINS, and  
W. A. ROCKIE.—Area Inspected by HUGH H. BENNETT.

### DESCRIPTION OF THE AREA.

Eastland County, Texas, lies in the central part of the State. Its center is about 85 miles west of Fort Worth and about 430 miles east of El Paso. The bordering counties are Shackelford, Stephens, and Palo Pinto on the north; Erath, Commanche, and Brown on the east, southeast, and south; and Callahan on the west. Eastland County is approximately  $30\frac{1}{4}$  miles wide along its west boundary and  $36\frac{3}{4}$  miles long on the north. The southern boundary is considerably shorter. The county includes 930 square miles, or 595,200 acres.

Eastland County lies on the eastern border of a southeastwardly sloping plateau, whose maximum elevation within the county is about 1,700 feet. The eastern boundary of this plateau lies, in general, a short distance east of the county line and consists of an escarpment overlooking a plain to the eastward, the latter lying about 400 feet lower. The



FIG. 1. Sketch map showing location of the Eastland County area, Texas.

Brazos River flows through both plains, crossing the higher one about 20 miles north of the northern boundary of the county. The watershed between the streams flowing northward directly into the Brazos and those flowing southeastward and by a circuitous route finally reaching the same stream, runs east and west across the northern part of the county. The former streams reach their master stream in a short distance, and because of this have been able to cut deep, narrow valleys. The latter streams, on the other hand, are long and have been unable to cut rapidly and deeply into the country they drain. The deeply dissected country north of the

main watershed and the smooth country south of the divide constitute the main topographic contrast in the county. In general, therefore, the topography of the county consists of a high plateau sloping gently southeastward, dissected, with the exception of a narrow belt along the northern part of the county, by southeastwardly flowing streams occupying shallow valleys.

The northern border of more thoroughly dissected and therefore rougher country ranges in width from 1 to 10 miles, the maximum width occurring in the northeastern and northwestern corners of the county. The larger streams in this belt have cut valleys to a depth of about 500 feet below the level of the plateau. An extension of the lowland plain to the east reaches up one of these valleys across the county line into the northeastern corner of Eastland County. The valleys of the larger streams are in the form of open basins, their sides consisting of successive escarpments and broad rock-supported benches. The deepest part of the valley, however, usually consists of a narrow gorge. South of the divide the streams have cut their valleys rarely more than 150 feet below the level of the adjacent plateau and in most cases much less. The flood plains here are usually broader than those on the northward-flowing streams.

The northern part of the county includes only relatively small areas of level to gently sloping land between the stream valleys. It consists largely of rather rough, hilly land, with some knobs and mesalike areas. The valley slopes are mostly steep and rough. In places the bottom lands are rather narrow, although in others they are wider and well defined.

In the southern half to two-thirds of the county level to gently rolling areas are much more extensive and a much larger proportion of the land is easily cultivable. The valley slopes are more rounded and smoother in outline. The average width of bottom lands varies from about one-eighth to three-fourths mile. The first bottoms are subject to overflow after heavy rainfall, but the alluvial lands include some fairly well defined terraces lying safely above the level of present floods. These terraces or second bottoms are developed in detached areas along some of the older drainage ways.

The greater part of Eastland County lies within the range of 1,500 to 1,700 feet above sea level. The extreme range is from 1,250 to 1,750 feet. In Brown County, about  $2\frac{1}{2}$  miles southeast of Rising Star, an elevation of 1,900 feet above sea level is reached in a mesa.

Eastland County was organized in 1873. The early settlers came from the eastern part of Texas and from States to the east and northeast. They were mainly of English extraction, and the present population is largely of English descent, although a small part is of German origin, and there are a few Mexicans and negroes. Over 98 per cent of the population consists of native whites. The county

is most densely settled along the Texas & Pacific Railway and south of this line. According to the 1910 census the total population is 23,421, or an average of 25.3 persons to the square mile. Possibly one-third of the population lives on farms and in the smaller rural settlements.

Cisco, with a population in 1910 of 2,410, is the largest town in Eastland County. Other towns, with their respective populations, are Gorman, 963; Eastland, 855; Rising Star, 640; Ranger, 586; Carbon, 479; Desdemona, 340; Mangum, 300; Sabanno, 160; and Scranton, 150. There are a number of small trading points, such as Nimrod, Romney, Kokomo, Rustler, and Dothan. Eastland is the seat of county government.

The Texas & Pacific Railway traverses the northern part of the county in a general east-west course. The Missouri, Kansas & Texas Railway (formerly the Texas Central) crosses the county in a north-west-southeast direction, making a junction at Cisco with the Texas & Pacific. The Cross Plains Branch of the Missouri, Kansas & Texas crosses the extreme southern part of the county, passing through Rising Star.

A few well-built county roads connect the larger towns, but the majority of the highways are in only fair condition. Telephone service reaches all the towns, as well as the country settlements and farm homes.

Cisco, Gorman, Eastland, Rising Star, Ranger, and Carbon, all situated on lines of railway, are important marketing centers and distributing points. Fort Worth, Dallas, Kansas City, St. Louis, and other large cities constitute the markets for the various farm products, such as cotton, poultry and eggs, hogs, and cattle.

#### CLIMATE.

There is no Weather Bureau station in Eastland County, but the records of the station at Dublin, in Erath County, given below, may be taken as representative of the local climatic conditions. These records show an average annual rainfall of 27.29 inches. The rainfall averages about 1.3 inches a month during December, January, and February, while for each of the remaining months of the year it averages nearly 2.6 inches.

The highest temperature on record, 106° F., occurred in the month of August. Temperatures of 102° or over have occurred in every month from May to September, inclusive. The lowest recorded temperature, -9° F., occurred in February. The mean temperature for the winter is 45.9° F., for the spring 64.2° F., for the summer 81.4° F., and for the fall 65.6° F. The mean annual temperature is 64.3° F.

The average date of the last killing frost in the spring is March 17, and that of the first in the fall November 14, an average period

of 242 days thus being free from killing frosts and suitable for the growing of summer crops. Killing frost has, however, occurred as late in the spring as April 5 and as early in the fall as October 26.

The native grasses cure on the root in early summer and when not overgrazed furnish pasturage practically the year round. Field crops suitable for pasturage can be grown throughout the year. The usual practice, however, is to grow only one crop a year in the same field, in order to allow the soil to store moisture for use by the next annual crop. Catch crops, nevertheless, are sometimes grown when the soil-moisture conditions are thought favorable.

During May, and especially June, and sometimes in July, there may occur hot south or southwest winds of such drying effect that all crops suffer more or less, even though the soil may have a fair moisture content. The crops commonly grown, such as cotton, grain sorghums, and Johnson grass, usually recover fairly well. Crops on sandy soils withstand these hot winds, as well as droughty periods, somewhat better than those on the heavier textured soils.

The following table of climatic data, compiled from the records of the Weather Bureau station at Dublin, shows the normal monthly, seasonal, and annual temperature and precipitation:

*Normal monthly, seasonal, and annual temperature and precipitation at Dublin, Erath County.*

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.
	<sup>° F.</sup>	<sup>° F.</sup>	<sup>° F.</sup>	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>
December.....	45.8	84	6	1.80	0.90	0.00
January.....	45.5	83	5	1.20	0	.53
February.....	46.4	92	-9	1.05	1.00	1.24
Winter.....	45.9	92	-9	4.05	1.90	1.77
March.....	57.5	96	21	1.37	.80	2.47
April.....	63.4	96	30	3.36	2.10	12.78
May.....	71.6	102	34	4.03	3.13	6.96
Spring.....	64.2	102	21	8.76	6.03	22.21
June.....	79.6	104	50	2.78	0	1.15
July.....	81.6	104	60	2.64	1.18	2.44
August.....	82.9	106	60	1.94	1.03	2.25
Summer.....	81.4	106	50	7.36	2.21	5.84
September.....	76.4	103	43	2.52	.70	3.37
October.....	65.3	97	29	2.82	1.45	4.21
November.....	55.1	84	20	1.78	1.40	2.10
Fall.....	65.6	103	20	1.12	3.55	9.68
Year.....	64.3	106	-9	27.29	13.69	39.50

## AGRICULTURE.

Until about the time of county organization (1873) the region in which Eastland County is situated was considered an isolated frontier. The principal interest of the early settlers was the grazing of horses, cattle, and hogs on the free range, the stock feeding on scrub-oak and live-oak mast, on shrubs and various plants, and on the native grasses. Some small acreages were devoted to field and garden crops, but the cultivated area did not increase markedly until after the building of the Texas & Pacific Railway in 1880 and the Texas Central (now the Missouri, Kansas & Texas) in 1881.

In 1880, according to the census, there were 549 farms in the county, comprising 100,817 acres, or 17 per cent of its total area. There were 5,867 acres in corn, 3,264 acres in cotton, and 941 acres in wheat. The minor crops of hay, barley, sweet potatoes, and oats collectively occupied 148 acres. About 3 per cent of the area of the county was in crops.

In 1890 there were 1,257 farms, occupying about 38 per cent of the county. There were 15,348 acres in cotton, 11,545 acres in corn, 4,328 acres in oats, 3,513 acres in wheat, and 685 acres in hay. Peaches, sweet potatoes, rye, Irish potatoes, apples, barley, and broom corn collectively occupied about 708 acres. About 6 per cent of the area of the county was cultivated.

In 1900 there were 2,510 farms, with a total area of 57,305 acres in cotton, 29,460 acres in corn, 2,743 acres in oats, 2,426 acres in coarse forage, 889 acres in millet, and 855 acres in wheat. These five crops occupied collectively more than 97 per cent of the total crop acreage, the remainder being devoted to peaches, apples, grapes, berries, rye, peas, peanuts, beans, sweet potatoes, Irish potatoes, sorghum, and a few other crops. About 69 per cent of the area of the county was in farms in 1900. The total acreage cultivated amounted to about 16 per cent of the area of the county. The value of all farm products not fed to live stock amounted to \$1,010,635 in 1899, and the income from domestic animals sold or slaughtered and from live-stock products aggregated \$262,889.

In 1910 there were 2,981 farms in the county. Over 71 per cent of its area was in farms, and about 20 per cent was cultivated. Since that year there has probably been some increase in the cultivated area. Cotton and live stock constitute the principal sources of income, while the cereals and hay and forage crops are used largely to support the live-stock industry in connection with grazing. Fruits and garden vegetables are grown largely to supply the home.

Cotton occupied 73.86 per cent of all land in crops in 1909, being grown on 87,441 acres. The production amounted to 22,214 bales, the average yield being slightly more than one-fourth bale per acre.

The only cereal crops reported by the 1910 census are corn, oats, kafir, and milo. Corn occupied 15,525 acres, oats 104 acres, and kafir and milo collectively 1,791 acres. The average yield of corn was only about  $6\frac{1}{2}$  bushels per acre. Cereal crops occupied 14.4 per cent of the total cultivated area, and the total value of the production was \$97,193. According to observations made during the soil-survey field work, kafir, milo, and feterita are now grown quite extensively, and wheat and oats on a fairly large acreage.

Hay and forage crops occupied 8,823 acres, or about 7.6 per cent of the total cultivated area, in 1909, with an average yield of slightly more than 1 ton per acre. The production amounted in value to \$107,308. There were only 18 acres in alfalfa, and the acreage yield averaged only about 1 ton of hay per season. Millet was grown on 1,355 acres and miscellaneous tame grasses on 1,476 acres. Wild hay was cut from 24 acres and grain hay from 208 acres. The largest area, 5,742 acres, was in coarse forage. Johnson grass, a volunteer perennial, grows on most farms. This crop often affords hay for early summer and fall cutting, and sometimes furnishes pasturage in mid-summer as well.

Sorghum was grown on 1,039 acres in 1909 and sugar cane on 6 acres. Sorghum yielded slightly more than 1 ton of forage per acre.

Peanuts were a rather important crop in 1909, occupying 1,082 acres. During the last few years there has been a marked expansion in peanut culture and the crop is now grown on an acreage many times larger than that in 1909. It is mainly confined to the areas of sandy land in the southern part of the county. The peanuts are used in part for hog feed and in part as a market product. Part of the crop is used for the extraction of peanut oil, the residue or peanut cake serving as stock food.

Crops grown to a small extent on almost every farm, partly for home use and partly for sale, include sweet potatoes, Irish potatoes, cabbage, onions, and other garden crops.

Artichokes for grazing by hogs are a successful crop on at least one farm in the southwestern part of the county, on sandy soil. A combination of peanuts and artichokes planted in alternate rows is said to make desirable hog pasturage.

Various orchard and small fruits are grown in a small way on practically every farm. There were 92,264 peach trees in the county in 1909, 58,427 apple trees, and 19,700 grapevines. Strawberries, blackberries, and dewberries are grown on a small total acreage. The production of pecan nuts is of considerable importance. There were 14,988 pecan trees in the county in 1909.

Live stock is kept to some extent on practically every farm in Eastland County, the value of all domestic animals in 1910 being

\$1,425,787. Animals sold or slaughtered in 1909 amounted in value to \$308,636, dairy products to \$103,999, and poultry products to \$105,197. The 1910 census reports 15,898 head of cattle in the county, 5,463 horses, 4,293 mules, 8,349 hogs, 465 sheep, and 2,650 goats. There were 2,536 calves sold or slaughtered in 1909, 4,965 other cattle, and 474 sheep and goats.

There are no large exclusive dairy farms in the county, but on a few farms near the towns considerable attention is given to the production of dairy products for local sale. Dairying is mainly carried on in connection with other farming activities. The butter production in 1909 amounted to 620,918 pounds. Income from dairy products sold in that year amounted to \$12,978.

There were 8,758 hogs sold or slaughtered on farms in 1909. The number of hogs raised has increased considerably since that year. The animals are largely sold from the farm, only such as are needed for home subsistence being slaughtered. Hogs are grazed in the natural pastures and fed on cowpeas, soy beans, grain, peanuts, and field-grown forage crops.

The native pasture includes many grasses and weeds that come up in early spring and afford grazing until June or later, depending upon the rainfall. As the weeds complete their growth, the mesquite grass takes possession of the land and affords green grazing until early summer, after which the growth cures on the root and if the pastures are not overstocked furnishes dry grazing until the following spring. Fall and winter pasturage is usually supplemented by leaves of the mesquite and live-oak trees and also by the mesquite beans or pods, while in some years acorns afford considerable feed for hogs. The abundance of native pasturage depends upon the rainfall, but under present conditions the pasture grasses are at least equal in value to the field crops grown for the support of the livestock industry.

In selecting soils for cultivation, the heavier textured types are largely used for the production of cotton, cereals, and forage crops. The sandy soils also are used for these crops, but peanuts, vegetables, and fruits are produced to a larger extent on these types than on the heavier soils. The stony lands and rough, hilly areas are used mainly for grazing. In the present state of agricultural development large areas are used for grazing that may ultimately be cultivated.

Land for summer crops is usually prepared in January and February. Some farmers flat-break the land and cultivate crops on the level, but most of them apparently prefer to plant intercultivated crops in listed trenches. Occasionally the sandy soils are broken with a middle buster and the high ridges are deeply furrowed with seed planters. This method practically amounts to planting in a listed trench. Thorough intertillage is quite commonly given to

keep down weeds and conserve soil moisture. The trenches are gradually filled and final cultivation leaves the land comparatively level.

Cotton, corn, milo, kafir, feterita, and peanuts are usually planted in March or April, or even later, depending upon the season and the supply of labor available. Cotton is picked from September to December, or even later in some years. The grain sorghums sometimes give two seed crops, but final harvest usually takes place by August or September. Such crops as small grain are put in with grain seeders on flat-plowed and harrowed land. Wheat is seeded in October and November and harvested the following May. Oats are sometimes sown in the fall, but usually from January 1 to February 15. The crop is harvested late in May or early in June. In favorable seasons, with good soil-moisture conditions, the small-grain crops are followed in July by millet or sorghum, grown as a catch crop for hay or pasturage. The usual practice, however, is to grow only one crop a year in any field.

On most of the farms there is little provision for the shelter of live stock during inclement weather, and buildings for storing farm machinery and crops are largely lacking. Most farms appear to be well equipped with modern implements for growing and handling the staple crops, including both walking and riding plows of standard-gauge moldboard and disk make, spike-tooth and disk harrows, both riding and walking cultivators of standard make, seed planters and grain drills, mowing machines, and grain binders. Two-horse to six-horse teams are used, the draft depending upon the implement used and the character and condition of the soil.

Systematic crop rotation is practiced only to a small extent, but the farmers shift from one crop to another in different fields and in this way meet many of the requirements of crop rotation.

Commercial fertilizers are not used in Eastland County. The soils seem well supplied with the readily soluble mineral constituents necessary for plant growth, and good crops are always obtained when the rainfall is adequate. The soils for the most part are not high in organic matter, and the application of well-rotted manure or the plowing under of green crops is advisable.

Farm laborers are mostly white and are generally efficient. The supply of labor seems abundant. Wages range from \$20 to \$25 a month with board, or from \$30 to \$35 without board. Day wages range from about \$1 to \$1.50 with board. The price paid for picking cotton varies from 60 cents to \$1 per hundred pounds of seed cotton.

The average size of farms, according to the 1910 census, is 140.9 acres. There are only a few large ranches in the county, and most of the farms contain between 100 and 300 acres.



According to the 1910 census, 51 per cent of the farms are operated by owners, 48.7 per cent by tenants, and 0.3 per cent by managers. Farms are rented mostly on a share basis. Where the owner furnishes a house, work stock, and machinery he takes one-half the crop. Where he furnishes only the land he takes one-third of the corn and grain crops, including both the nonsaccharine sorghums and small grain, and one-fourth of the cotton.

In 1910 the average value of all farm property was \$3,478 per farm, of which 70.2 per cent of the value was in land, 12.5 per cent in buildings, 3.3 per cent in implements, and 14 per cent in domestic animals. The average land value was \$17.32 an acre. At the present time, according to local estimates, cultivated lands range in price from \$15 to \$35 or more an acre, depending upon the location and improvements. Stony pasture lands bring from \$4 to \$10 an acre.

#### SOILS.

The upland soils of Eastland County have been derived from the underlying rock, consisting of sandstones, conglomerates, and limestones. The former two predominate over the higher parts of the county, except in mesas in the southern part, which are formed of limestone. With the exception of these mesa areas the soils derived from limestones are found rather low on the slopes of the valleys in the central and southern part of the county and always below the level of the highest part of the plateau in the area of rough land in the northern part. The predominant surface rock of the county is sandstone, and the predominant soils are derived from sandstone. The limestone beds have not only a smaller area of surface distribution, but they are thinner than the sandstone beds. They are somewhat thicker in the eastern than in the western part of the county.

The prevailing color of the upland soils, not including the sands, the relatively poorly drained, and the imperfectly developed soils, is brown to very dark brown with a tinge of red, while that of the subsoils is reddish. The less well drained types, whether the condition be due to topographic position or to texture, are dark brown to black in color; the sands are gray. The imperfectly developed soils, brown as a rule in the immediate surface, have subsurface and subsoil colors approaching those of the parent rock.

The soil material that on the basis of its topographic position seems to be the oldest and to have occupied its existing place longer than any other in the county, is the layer of sand described in this report as Nimrod fine sand. It occupies the narrow watershed ridges of the southern part of the county, a position not yet reached by active erosion of the existing cycle. It consists either of the remnants of an old deposit originally covering a large part or all of the county,

or it is a residual product of the sandstones of the region from which all the finer grained material has been removed by rainwash during the long time that it has occupied its present position. The evidence seems to point to the latter mode of origin. It is underlain by yellowish clay often mottled with red, especially in the upper part. This is similar in color to the mottled yellow and red clay found in the deep subsoil of the other soils derived from sandstone but as a rule is stiffer.

Fringing the area of the occurrence of this sand material, and lying on the upper, gently sloping approaches to the adjacent valleys, is a belt of the same sand, mapped as the shallow phase of the Nimrod fine sand, in which more active erosion has reduced the thickness of the deposit. This soil is exactly like the typical soil, except in the shallower depth to the underlying heavier material.

Occupying the higher part of the broad rolling belts along both sides of every stream in the central and southern part of the area and practically all the higher plateau land of the northern part is a series of sandstone-derived soils generally with brown to reddish-brown surface soils and red, usually rather heavy subsoils resting upon the disintegrated parent rock at less than 3 feet. The soils of this description have developed in situations where erosion has been sufficiently active to prevent a surface accumulation of sand by removing both sand and finer material from the surface rather than fine material only, as seems to have been the case in the development of the Nimrod soils, and yet not active enough to prevent the formation of a true soil layer over the parent rock. These soils have been identified as members of the Windthorst series.

Having the same topographic position, so far as relief is concerned, but lying farther down the valley slopes in the central and northern parts of the county and on the high mesas in the southern part, is a series of soils derived from limestone, the members of which have rather heavy and, where well developed, brown to reddish brown soils, overlying red clay subsoils. Where developed from thoroughly consolidated beds of limestone the rock usually lies within 3 feet of the surface and the well-weathered red clay rests on the rock with a very thin layer of disintegrated highly calcareous material between it and the unweathered limestone. Where the soil has been imperfectly developed and overlies soft marly or shaly limestone or highly calcareous clay it is dark brown and is underlain at depths of less than 3 feet by the highly calcareous grayish parent rock. The reddish types of these limestone soils have been identified as members of the Crawford series and the other as a member of the Brackett series.

In small basins within the area of the Nimrod fine sand soil material has been accumulated by wash from surrounding areas. As

a result of rather poor drainage it has developed into a dark-colored soil with considerable concentration of carbonates. This has been correlated with the Simmons series, though it is not considered as typical Simmons in all respects.

On strips of gentle slope and flat filled-in valleys, closely associated with the Crawford soils of the northern part of the county, there has been an accumulation of wash from limestone and sandstone material, predominantly the latter, it would seem. This has developed into a dark-colored soil with a dark-brown somewhat heavier subsoil. It has been correlated with the Simmons series, though, like the soil described above, it may not be typical of the series, the calcareous hardpan of the typical soil not having been reached in the sections examined and its presence at a greater depth not established.

Belts of alluvial material have been accumulated along all the larger streams varying in width on account of the varying resistance of the rock. Soils derived from this material have been correlated in the Frio series. Small areas of old alluvium which have developed into soils of the Teller series were mapped.

None of the soils of the county, excepting the members of the Nimrod series, are low enough in their lime content to be considered noncalcareous, though none of them except those in which the subsoil consists essentially of the parent rock (Brackett) or those in which salts have been concentrated by drainage waters (Simmons) effervesce freely in acid.

The material of the Windthorst series is residual from sandstone, shale, and conglomerate. The color of the surface soil varies from reddish brown to brown, with shades of red. The subsoil consists of reddish, compact clay, frequently showing yellow and gray mottling in the lower part. The yellow mottling appears to represent, at least to a considerable degree, disintegrated rock material in which weathering is less advanced than in the red material. The material does not effervesce within the 3-foot section. These are well-drained soils, occupying nearly level to rough or broken country. Four types are mapped—the stony loam, gravelly sandy loam, fine sandy loam, and clay loam, the last with a sandy phase.

The Nimrod soils are characterized by the very light brown to grayish color of the surface material, in the case of the sandy types, and the yellow or greenish-yellow to mottled yellowish, reddish, and grayish color and tough structure of the underlying clay. The material is residual from sandstone and sandstone conglomerate and is noncalcareous to depths even greater than 3 feet. The surface is level to hummocky. The soils, at least the sandy members, hold moisture well. These soils are closely related to the Windthorst in origin. They are not so well drained. The subsoil of the series is not so red

as that of the Windthorst, probably because of the more nearly level surface and consequently poorer drainage and less advanced oxidation. Probably the greater depth of sand is due to the slower removal of the material by erosion, as a result of the less rolling surface, though in places it may be due to accumulation by wind. In this county the fine sand, with a deep phase, is the only type of the Nimrod series mapped.

The surface material of the Crawford soils ranges in color from reddish brown to chocolate brown. The subsoil is mostly red, consisting of moderately stiff clay, generally calcareous. Limestone is usually reached within 3 feet of the surface. Two types of this series are mapped, the stony clay, with a dark-colored phase, and the clay loam.

The soil of the types included in the Brackett series varies in color from dark gray to brownish gray. The subsoil consists of grayish to brownish or yellowish calcareous clay in the upper part and whitish or mottled grayish and yellowish clay in the lower part. In many places the lower material is chalky. The Brackett soils are well drained. They occupy for the most part slopes and rough eroded country, but there are some smooth areas. Three types are mapped—the stony loam, the fine sandy loam, and the silty clay loam, with an eroded phase.

The types in the Simmons series are characterized by dark-brown to black surface soils and a stiff clay subsoil having the same color range in the upper part and becoming somewhat grayer with depth. The material is usually calcareous, at least in the lower subsoil. These soils seem to be largely derived from what is believed to be outwash-plain or old valley-filling material. In the substratum a very tough clay or limestone hardpan, of the nature of "concrete," is probably present in many places. Some of the soil is residual, and probably is the same as the San Saba of San Saba County, Tex. The Simmons soils occupy level areas which are inadequately drained in seasons of considerable rain. Some areas of these soils apparently represent colluvial accumulations of soil over flat areas, where imperfect drainage has caused the dark color of the material. In this survey the Simmons fine sandy loam and clay loam are mapped.

The Teller series, represented by only one type, the fine sandy loam, occurs on stream terraces standing well above overflow. The color of the surface material varies from brown to reddish brown, while that of the subsoil is red. The lower subsoil is frequently calcareous.

The Frio series includes all the recent-alluvial soils of the county, more or less subject to overflow. The surface material varies from brown to dark brown. The subsoil consists of brown to grayish-brown silty clay. The lower subsoil is usually calcareous, although

in places the material within the 3-foot section does not effervesce with hydrochloric acid. These soils consist of recently deposited alluvium washed from the various upland soils of the region. Two types of the Frio series are mapped in this area—the fine sandy loam and the silty clay loam.

In the following pages the various soils of Eastland County are described in detail and their relation to agriculture is discussed. The map accompanying this report shows the distribution of each type, and the actual and proportionate extent of each is shown in the following table:

*Areas of different soils.*

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Windthorst fine sandy loam..	109,056	18.4	Windthorst gravelly sandy		
Nimrod fine sand.....	71,680	17.7	loam.....	27,968	4.7
Deep phase.....	33,600		Frio silty clay loam.....	25,556	4.3
Windthorst stony loam.....	56,640	9.5	Simmons clay loam.....	25,792	4.3
Brackett stony loam.....	54,336	9.1	Rough stony land.....	17,408	2.9
Windthorst clay loam.....	24,192	7.9	Frio fine sandy loam.....	11,200	1.9
Sandy phase.....	22,848		Teller fine sandy loam.....	8,192	1.4
Brackett silty clay loam.....	29,376	6.1	Simmons fine sandy loam.....	3,840	.7
Eroded phase.....	7,104		Brackett fine sandy loam.....	2,944	.5
Crawford clay loam.....	33,336	5.6	Total.....	595,200	
Crawford stony clay.....	22,272	5.0			
Dark-colored phase.....	7,350				

## WINDTHORST STONY LOAM.

The surface soil of the Windthorst stony loam consists of 10 to 15 inches of light-brown to reddish-brown sandy loam to fine sandy loam, containing fragments of sandstone and pebbly conglomerate, underlain mainly by compact or tough, red clay. The lower subsoil usually has a tough structure and is mottled with yellow, but in places the red color continues uniform throughout the 3-foot section. In many included areas the surface material varies from clay to clay loam, and in patches the subsoil is mottled yellow and gray throughout. In places the small quartz, chert, and dark-colored gravel particles characteristically encountered in greater or less abundance on the surface are also present in the subsoil. The material is typically not calcareous within the 3-foot section, but in a few small areas near limestone beds there is a slight calcareous reaction. Bedrock of sandstone, shale or pebbly conglomerate is usually encountered within the 3-foot section, and massive exposures of these rocks occur more or less abundantly over much of the type.

This type occurs extensively in the northern third of the county, where it forms some rather large areas. Throughout the remainder of the county it occurs in areas of various sizes associated with other

types of the series. In places the surface is comparatively level or moderately sloping, but the usual topography is rather hilly and broken, with steep, stony slopes. Drainage is generally good and in some places excessive, so that the soil is readily affected by droughts.

Only a few small areas of this type are suitable for cultivation. It is used largely as pasture land, for which it is apparently as valuable as any other soil in the county.

The characteristic tree growth consists of blackjack and post oak. In areas of thin soil and those lying adjacent to limestone there is in addition a scattered growth of mesquite trees. There is an undergrowth of various kinds of thorny brush and chaparral. The rains of early spring and summer stimulate a dense growth of grass, which cures on the root during early summer and provides continuous pasturage until the following spring. The leaves of the tree and brush growth often supply additional late-summer and fall browsing. In some years acorns are quite plentiful. These are readily eaten by hogs, and by other live stock when hard pressed for food.

Land of the Windthorst stony loam type is held at \$4 to \$8 an acre, depending on the location with respect to towns and shipping points.

#### WINDTHORST GRAVELLY SANDY LOAM.

The Windthorst gravelly sandy loam consists of a reddish-brown to grayish or light-brownish gravelly fine sand to fine sandy loam. 8 to 20 inches deep, underlain by compact, red to mottled red and yellow, gravelly clay. The subsoil shows the same color variation as that of the Windthorst fine sandy loam. The gravel content in both surface soil and subsoil is in places very high, but over the greater part of the type is not sufficient to interfere seriously with cultivation. In places scattered fragments of sandstone and sandstone conglomerate occur.

This type occurs quite extensively in the northern third of the county and to a somewhat lesser extent throughout the remainder. It occupies level to gently sloping areas, with some low knolls and ridges. Surface drainage is good, but, as a rule, not excessive. The subsoil is retentive of moisture.

The Windthorst gravelly sandy loam, owing to its power to resist drought, is one of the more desirable soils of the county. Possibly two-thirds of it is under cultivation, the remainder supporting a native growth of blackjack and post oak and various kinds of brush.

The type is used for the production of the same crops as are grown on the Windthorst fine sandy loam. The crop yields, farming methods, and land values are about the same as in the case of that soil.

## WINDTHORST FINE SANDY LOAM.

The Windthorst fine sandy loam consists of a light reddish brown to reddish-brown loamy fine sand or fine sandy loam, 10 to 20 inches deep, underlain abruptly by rather compact or tough, red clay, which either shows no change within the 3-foot section or is mottled with yellow and tougher in the lower part than in the upper part. In places the upper subsoil is reddish yellow, light red, or red faintly mottled with yellow, but its characteristic color is medium red. Gravel fragments of quartz, chert, and other rocks occur in places on the surface and in the soil mass, as well as occasional larger fragments of sandstone, shale, and pebbly conglomerate, but not in sufficient quantity to interfere with cultivation. The rock substratum consists of sandstone or conglomerate. The soil material is non-calcareous.

As mapped the type includes some unimportant patches of other soils, such as the Nimrod fine sandy loam and soil derived wholly or in part from limestone and calcareous material. In places whitish, chalky, calcareous material underlies the tough, noncalcareous clay within the 3-foot section.

The Windthorst fine sandy loam is quite extensively developed throughout the county, occupying level to gently rolling and sloping areas. In the central and southern parts of the county, where it is associated with the Nimrod soils, it occupies slightly higher country than the latter, such as low knolls and broad ridges. The type has good surface drainage. The clay subsoil prevents excessive under-drainage and is retentive of moisture.

On account of its drought-resistant qualities this type is recognized as one of the better general-farming soils in the county. Possibly three-fourths or more of its total area is in cultivation, the remainder supporting blackjack and post oak and a growth of various kinds of thorny brush. With favorable spring and summer rains there is a fairly good growth of grass.

The principal crops grown on this type are cotton, corn, kafir, milo, feterita, Johnson grass, and peanuts. Hogs and beef cattle are raised on most farms to some extent in connection with general farming, and butter and cream are produced for sale. On several farms there are small orchards of peaches and apples and plantings of small fruits, such as strawberries and dewberries. Vegetables are grown for home use and to some extent for sale.

Cotton yields about one-fourth to three-fourths bale per acre,<sup>1</sup> corn and grain sorghum about 10 to 30 bushels, and Johnson-grass hay 1 to 3 tons per acre. The yield in most cases is dependent upon the amount and distribution of the rainfall.

<sup>1</sup> Statements as to yields are based upon reports of farmers.

Preparation of the soil for summer crops is usually made during January and February. Turning plows, middle busters, disks, and harrows are used, with 2-horse to 4-horse teams. Planting is done in March and April. Intertilled crops, such as cotton, corn, grain sorghums, and peanuts, are usually planted in trenches, though some farmers practice level culture. Cultivation is thorough, and both riding and walking cultivators are used. For winter crops the soil is usually plowed and harrowed early in the fall or disked without plowing. Wheat is sown with the drill. Oats are sometimes sown in the fall, but usually in January or February. Commercial fertilizers are not used on this soil and barnyard manure is seldom applied.

The price of land of the Windthorst fine sandy loam ranges from \$15 to \$30 an acre, depending upon the improvements and the nearness to towns and lines of transportation.

On account of the low average yield of cotton, due to the boll weevil and variable rainfall, it would seem advisable either to devote part of the acreage now used for cotton to drought-resistant crops such as corn, milo, kafir, and feterita, all of which are excellent livestock feeds, or else to enlarge the farming operations so as to include such crops upon a larger acreage, as the basis of an increased production of beef cattle and hogs. By manuring the cotton land and plowing under green-manure crops it would be possible to obtain the same production on a smaller acreage.

#### WINDTHORST CLAY LOAM.

The Windthorst clay loam consists of a light to medium reddish brown sandy clay loam or clay loam, 6 to 10 inches deep, underlain by a red to dull-red, compact clay mottled in the lower part of the 3-foot section, with gray and yellow. In places the subsoil is uniformly reddish throughout, but the substratum clay beneath usually shows mottlings. The lower subsoil is tougher than the material above. Small quartz, chert, and other dark-colored gravel particles occur on the surface and in places throughout the subsoil, in addition to scattered fragments of sandstone and conglomerate. As a rule these do not interfere with cultivation. The typical clay subsoil does not effervesce with hydrochloric acid. Owing to its rather heavy texture, the surface soil has a tendency to bake or harden after heavy rains, and frequent cultivation is generally necessary to maintain a friable tilth.

The Windthorst clay loam occurs mostly in the northern third of the county. The surface in general ranges from level to gently sloping. Surface drainage is usually adequate.



The Windthorst clay loam is not considered as desirable as the sandy types with clay subsoils, owing to its greater susceptibility to drought. Under good cultural methods and in years of normal rainfall, however, there is no material difference in the yields, as the soil is naturally strong. Possibly half of it is in cultivation, the remainder being used for pastures. The uncultivated areas support a growth of scrub oak and brush. Native grasses make a good growth when there is sufficient rainfall, affording pasturage practically the year round. The crops consist mainly of cotton, corn, milo, kafir, feterita, and Johnson grass. Crop yields are rather more uncertain on this type than on the sandy soils, and probably average somewhat lower. Practically the same live-stock industries are engaged in as on the fine sandy loam.

This soil is handled in much the same way as the sandy soils. It probably requires more frequent and more thorough cultivation, owing to its tendency to crust, especially following heavy rains. Commercial fertilizers are not used, and animal manure is applied in only a few instances.

Land of this type is held at \$15 to \$30 an acre, the price depending upon the state of improvement and the nearness to towns and lines of transportation.

The type as a whole seems to be rather low in organic matter. It would be advisable to supply this in the form of well-rotted animal manure or by plowing under a green cover crop of some kind. Green manuring, in conjunction with occasional deeper plowing, would tend to provide a deeper and more friable soil, capable of withstanding drought better. Owing to the uncertainties incidental to cotton culture it would seem advisable to reduce the acreage in this crop and to extend the growing of the grain sorghums and forage crops, in connection with the raising of larger numbers of live stock.

*Windthorst clay loam, sandy phase.*—The Windthorst clay loam, sandy phase, consists of a layer of fine sandy loam, about 2 to 4 inches deep, overlying the typical clay subsoil. It represents areas in which deep plowing brings the underlying clay to the surface, forming a sandy clay loam or light clay loam. This phase is an intermediate soil between the clay loam and fine sandy loam of the Windthorst series. Cultivation is somewhat easier than on the clay loam, with which it is usually associated. The topography, drainage, crops grown, and natural adaptation, however, are about the same, the clay subsoil lying near enough the surface to have a controlling influence.

In the following table are given the results of mechanical analyses of samples of the soil and subsoil of the typical Windthorst clay loam:

*Mechanical analyses of Windthorst clay loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
444701.....	Soil.....	0.6	0.6	1.4	37.6	14.0	17.6	27.7
444702.....	Subsoil.....	.4	.6	.6	25.9	15.4	38.6	18.7

NIMROD FINE SAND.

The Nimrod fine sand consists of a very light brown to grayish, loose fine sand to loamy fine sand, 12 to 30 inches deep, underlain abruptly by a yellow, stiff clay which is frequently mottled with red in the upper part and with gray in the lower part. In places the upper subsoil shows more red than yellow, but characteristically yellow either predominates or is the sole color in the upper part, while some grayish or reddish yellow appears in the lower part. The subsoil is very tough when dry and plastic when wet, and is non-calcareous. The surface material dries out to a light-gray color.

This type occurs extensively within the southern half of the county. Its surface in general is flat to gently sloping, with some knolls and ridges, probably formed by wind action. The inter-stream areas of the type generally occupy relatively lower levels than adjacent soils of the Windthorst, Brackett, and Crawford series, while in areas bordering main drainage ways the contrary is more frequently the case.

Owing to the generally rather flat surface of this type and dense clay subsoil and substratum, the soil with heavy rainfall soon assumes a more or less pasty quicksand consistency, which remains for a considerable time before the moisture is dissipated. Such conditions are not as a rule injurious when they occur early in the spring or after crops are well established. Aside from this the areas are naturally well drained. It is said that on some areas of the type one or two good spring rains are sufficient to insure summer crops.

The Nimrod fine sand is locally considered a valuable soil. Possibly 80 or 90 per cent of its area is in cultivation. The remainder supports a growth of scrub oak, shin oak, brush, and grasses, and is used for grazing.

The principal crops are cotton, corn, milo, kafir, feterita, and Johnson grass. Wheat, oats, fruits, and garden vegetables are grown to some extent. The yield of cotton ranges from one-fourth to three-fourths bale or more per acre, depending on the rainfall.

Corn yields 10 to 25 bushels, grain sorghums 10 to 30 bushels, wheat 5 to 20 bushels, and oats 10 to 30 bushels. Johnson grass yields 1 to 3 tons of hay per acre. Following the harvesting of winter or early summer crops, crab grass makes a good growth. This crop is used for hay and pasture.

In recent years considerable attention has been given to peanut culture, especially in the vicinity of Gorman, Carbon, and Rising Star. This industry seems to be expanding rapidly, the peanuts being grown for sale, for the production of oil, and as a pasture crop. The planting period extends from late in March to early in June, and the crop matures in October. When the nuts are harvested for market the vines are often utilized for hay. Yields of peanuts are said to range from 10 to 50 bushels per acre. Returns average higher than on soils of heavier texture.

Cattle, hogs, and poultry are raised in connection with general farming, the cereal and forage crops being used largely to feed stock. Some dairying is carried on.

The soil is usually prepared for summer crops in January and February. Planting follows in March or April or later, depending on the character of the season and the supply of labor. Cotton, corn, grain sorghums, and peanuts are usually planted with planters, which can be gauged to place the seed in furrows of any desired depth. Subsequent cultivation, which is usually frequent and thorough, gradually refills the furrow, finally leaving the land level and smooth. This method of planting is said to insure better germination should dry weather prevail. In wet years, however, it has some disadvantages. For this reason it is modified by some farmers, and the cultivation in practice ranges from almost level planting to deep-furrow planting, according to the moisture conditions expected.

For winter crops the soil is either plowed and harvested early in the fall or disked without plowing. Wheat is sown with the drill, usually in October. Oats are sometimes sown in the fall, but usually in January and February. Commercial fertilizers are not used on this soil, and barnyard manure is seldom applied.

The price of land of the Nimrod fine sand type ranges from about \$20 to \$35 or more an acre, depending on the character of improvements and the situation.

This soil in general seems rather deficient in organic matter. The application of barnyard or green manure would not only make the soil more productive, but would tend to promote a better tilth and reduce the tendency of the soil to drift in unprotected fields. Owing to the rather low average yields of cotton, it might be profitable to give more attention to the growing of forage crops and the raising of beef cattle and hogs. Milo, kafir, feterita, and such forage crops as Sudan grass, sorghum, and millet succeed. Johnson grass grows

wild, and the appearance of fields where Bermuda grass has been used as a soil binder indicates that this crop could well be grown more extensively for permanent pasture. Peanut growing offers a promising field on this type.

*Nimrod fine sand, deep phase.*—The Nimrod fine sand, deep phase, consists of a very light brown to light-gray loose fine sand to loamy fine sand, 3 to possibly 5 or 6 feet deep, passing abruptly into mottled yellow and gray clay of stiff, dense structure. In small included areas the clay occurs within the 3-foot section. The irregularity in the depth to clay may be due in part to the manner of original deposition, but the appearance of areas devoid of timber or native vegetation would seem to indicate that it is largely due to wind action. The phase is locally called "blow sand."

Some large areas of this soil occur in the central part of the county, and several smaller developments are mapped in the southern half. The surface on the whole is fairly level, though in places it is hummocky or dunelike. Drainage is thorough, and in places where the clay lies at great depth the phase is inclined to be droughty.

The Nimrod fine sand, deep phase, is fairly extensive, but on the whole it is not important agriculturally. In patches where the underlying clay lies about 3 feet below the surface and where trees act as a windbreak, the soil gives fairly good yields. Possibly 5 per cent of the phase is in cultivation, the remainder supporting a growth of scrub oak, shin oak, brush, cacti, and various grasses.

This soil seems to be best adapted to use as pasture. In rainy seasons grasses make a fairly good growth, but overgrazing or dry weather reduces the pasturage value more quickly than on other soils. It would seem advisable to keep the soil either in its native cover or in Bermuda grass or other grasses that would not only furnish pasturage but would serve to prevent drifting.

In the following table are given the results of mechanical analyses of samples of the soil and subsoil of the typical Nimrod fine sand and the soil of the deep phase of the type:

*Mechanical analyses of Nimrod fine sand.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
444711.....	Soil.....	0.3	3.9	10.2	70.0	7.0	6.6	1.8
444712.....	Subsoil.....	.1	1.4	4.6	38.6	6.6	4.8	43.9
<i>Deep phase:</i>								
444713.....	Soil.....	0.9	3.0	8.2	73.0	6.4	7.0	1.2

## CRAWFORD STONY CLAY.

The fine-earth material of the soil of the Crawford stony clay consists of a clay loam to clay, reddish brown to chocolate red in color, with which is mingled varying proportions of limestone fragments, and in scattered areas small gravel particles of quartz, chert, and other rocks, as well as larger fragments of conglomerate, remnants of formerly overlying rocks, such as give rise to the Windthorst soils. The subsoil in places consists of a layer of the red calcareous clay 1 to 2 feet thick. In many places massive limestone is encountered in the lower subsoil, and exposures of rock also occur.

The Crawford stony clay is fairly extensive in the northern part of the county and is scattered in small bodies throughout the remainder. It is closely associated with other Crawford soils and the members of the Brackett series, and is developed where the underlying rock is prevailingly limestone.

The type includes considerable areas of fairly level to gently sloping surface, with some steep slopes. Small rough or rocky areas occur more or less frequently throughout the type. Drainage is for the most part thorough, and in places the type is droughty, owing to the thinness of the soil material.

A few important areas are cultivable, but as a whole the type is apparently best adapted to use as pasture land, and it is largely used for this purpose. Its pasturage value is equal to that of any other type in the county.

The characteristic vegetation on this soil consists of live oak and mesquite, with the usual bushy undergrowth. An abundant growth of grasses follows the early spring and summer rains, and if the season is not excessively dry these afford grazing until the following spring. Mesquite beans and the leaves of the live oak and mesquite furnish additional browsing, and in some years mast is abundant.

The price of the Crawford stony clay ranges from \$4 to \$8 an acre, depending largely on the location.

*Crawford stony clay, dark-colored phase.*—The dark-colored phase is essentially similar to the typical Crawford stony clay except in color and topographic situation. The soil ranges in color from brown to dark chocolate red or black. This phase is not extensive. It is developed mainly in the northern part of the county. Over much of its extent it occurs in high, mesalike areas, flanked by steep slopes occupied by stony soils of the Brackett series. The native growth on the phase and its agricultural adaptations are the same as in the case of the typical soil.

## CRAWFORD CLAY LOAM.

The Crawford clay loam consists of a reddish-brown to dark chocolate brown clay loam, 5 to 8 inches deep, underlain by chocolate-

red to light-red compact clay. Gray mottled, chalky material appears in the lower part of the subsoil. Limestone is often encountered at a depth of 2 or 3 feet. In places the immediate surface material is sandy and gravelly. Sandstone and conglomerate fragments, consisting apparently of remnants of overlying strata largely removed by erosion, occur in scattered areas, as well as fragments of the underlying limestone. As mapped, the type includes patches in which the surface soil is Brackett and Windthorst material and others in which the subsoil is Brackett material. The typical Crawford soil is residual from limestone only.

The Crawford clay loam is developed in fairly large areas in the northern third of the county and in smaller scattered bodies throughout the remainder. The type occupies rather broad, gently undulating or gently sloping valley areas, with few steep slopes. Surface drainage is for the most part adequate. With good cultivation to reduce evaporation the clay subsoil retains sufficient moisture for crop use, but otherwise, or in dry years, crops suffer more than on the sandy types.

This soil is one of the more desirable soils of the county. About one-half of it is devoted to cultivated crops, the remainder being largely used for pasture. The vegetation consists largely of mesquite and live oak, with the usual undergrowth of thorny brush and shrubs. Grass makes a good growth in favorable seasons. Rainfall conditions affect the pasturage quite as much as the field crops.

Cotton, milo, kafir, feterita, Johnson grass, and corn are the principal crops. Some sorghum and millet are grown, as well as wheat and oats. Cotton yields one-fourth to three-fourths bale, grain sorghums 10 to 30 bushels, and corn 10 to 20 bushels per acre. The yield of Johnson-grass hay ranges from 1 to 3 tons per acre. Fruits and garden vegetables are produced to some extent. Dairying is carried on in a small way in connection with general farming, as is also the raising of hogs, cattle, and poultry for home and local use. The farming practices and the methods of handling the soil are practically the same as in the case of the Brackett silty clay loam.

The price of this land ranges from about \$15 to \$30 an acre, depending on the improvements and location.

Plowing is usually rather shallow, because of fear of loss of moisture where deep breaking is practiced. Where plowing is done several weeks in advance of planting, however, as in the case of preparation of the land for summer crops during the winter season, damage from this cause would be lessened. Deeper plowing at least every other year would develop gradually a deeper and more friable seed bed that would provide better against droughtiness, especially if organic matter in suitable form were incorporated with the soil. In

the absence of well-rotted manure, the plowing under of a green cover crop would aid greatly in increasing the friableness of the soil, as well as its retentiveness. On account of its heavy texture, the soil in most places tends to form a crust and to bake badly after heavy rains. Owing to the rather low average yields of cotton, it would apparently be advisable to reduce the cotton acreage materially and to grow instead more subsistence crops, such as corn, feterita, milo, kafir, Sudan grass, sorghum, and millet. Raising live stock seems to be the most dependable branch of agriculture under the existing conditions.

BRACKETT STONY LOAM.

The surface soil of the Brackett stony loam includes loamy to clayey material, brownish to gray in color, with a variable content of limestone fragments. In scattered areas there is also an admixture of small gravel particles and sandstone-conglomerate fragments, derived from higher lying areas of the Windthorst soils. The subsoil and substratum in many instances consist of gray to greenish-yellow or mottled yellowish and grayish calcareous clay. Limestone is encountered at or near the surface and at depths of 1 to 3 feet. This type has more soil material and constitutes better pasture areas than Rough stony land, into which it grades.

The Brackett stony loam occurs in large areas in the northern third of the county. In other sections it is developed mainly in small scattered areas. The type occurs where the underlying rock is chiefly limestone.

This soil occupies rather rough and hilly areas, with steep, stony valley slopes and gullies. There are some unimportant relatively level to gently sloping areas, rather stone free, which admit of cultivation. The land is for the most part well drained. In places the type is droughty, owing to the thinness of the soil material.

The characteristic tree growth on this type consists of live oak and mesquite. In places, as in the vicinity of Cedar Mountain, in the north-central part of the county, and in the east and northeast valley section, where the limestone strata are thick, cedars of a size suitable for fence posts are more or less abundant. The undergrowth throughout the type consists of the common thorny brush and shrubs, and grasses. The latter cure on the root and afford grazing until the following spring. The trees furnish browsing and mast. In the rough valley areas of the type stock finds shelter from cold winds.

The Brackett stony loam is used mainly as pasture land. It is held at \$4 to \$8 an acre, depending on the location.

BRACKETT FINE SANDY LOAM.

The Brackett fine sandy loam consists of a brownish to dark-grayish fine sandy loam, 8 to 10 inches deep, underlain by a light-

brown, compact silty clay subsoil, which in the lower depths becomes lighter gray and strongly calcareous. Gray, calcareous clay composes the substratum. The surface soil in places carries small gravel, particles of quartz, chert, and other rock, together with some limestone, sandstone, and conglomerate fragments. These do not occur in sufficient quantities to interfere with cultivation.

The type is of mixed origin, the surface soil being derived apparently either from overwashed or residual Windthorst material, while the subsoil, at least in the lower part, is residual from the underlying limestone. The material in the upper 2 feet of the 3-foot section shows considerable variation in color and composition.

The Brackett fine sandy loam is not extensive, occurring only in a few relatively small areas in the eastern part of the county. It usually occupies areas lower than the adjacent Windthorst soils. The surface varies from level to gently sloping, and the drainage is adequate. The retentive character of the subsoil aids the type in resisting drought.

The Brackett fine sandy loam is one of the more desirable soils in the county. Possibly one-half of it is devoted to cultivated crops, the remainder being used as pasture land. The tree growth consists predominantly of mesquite and live oak. The usual undergrowth occurs, and native grasses afford good pasturage in favorable years.

Cotton, corn, grain sorghums, and Johnson grass are the principal crops. In recent years peanuts have become somewhat important. Cattle, poultry, and some sheep and goats are raised.

The crop yields and farming methods on this type are practically the same as on the Windthorst fine sandy loam. The type can be improved by the same farming methods.

#### BRACKETT SILTY CLAY LOAM.

The Brackett silty clay loam consists of a brownish-gray or dark-gray to yellowish silty clay loam, 5 to 8 inches deep, underlain by a compact, brownish silty clay which with depth becomes grayer in color and frequently shows some yellow mottling. The material is strongly calcareous in the last foot of the soil section and in the substratum, which consists of a more distinctly gray clay.

In places the surface soil varies in texture, ranging from a somewhat loamy material to a heavy clay. The latter under cultivation and in normal moisture condition has a friable structure, but in the native sod or after a soaking rain it bakes and becomes rather compact. In places the surface material contains some pebbles of quartz, chert, and other rock, and fragments of sandstone, conglomerate,



and limestone, derived from higher lying areas of the Windthorst soils. This coarse material is not sufficiently abundant to interfere appreciably with cultivation.

This type occurs throughout the county, but is most extensive in the northern part. It is associated with areas of limestone rock. The type in general occupies comparatively broad and level areas, the surface ranging from gently undulating land to long, gentle valley slopes. As a rule the surface drainage is adequate. The clay subsoil is retentive of moisture, but unless the surface is kept well cultivated the type is much more susceptible to drought than are the more sandy soils.

The Brackett silty clay loam is one of the more desirable soils of the county. About one-half of it is cultivated, the remainder being used for pasture. The native vegetation consists mainly of mesquite and live oak, with the usual thorny-brush undergrowth. Native grasses furnish good pasturage in favorable years. The value of the pasturage and the yields of crops vary considerably with the rainfall.

Cotton, corn, milo, kafir, feterita, and Johnson grass are the principal crops. Some dairying is carried on in connection with the growing of field crops, and hogs, beef cattle, and some sheep and goats are raised. Cotton yields about one-fourth to three-fourths bale per acre, corn 10 to 20 bushels, and grain sorghums 10 to 30 bushels. Johnson grass yields 1 to 3 tons of hay per acre.

Preparation of the soil for summer crops is usually done during January and February, and planting in March or April or later. Intertilled crops are usually planted in furrows, which are gradually filled with cultivation, leaving the surface level when the crops are laid by. For winter crops the soil is usually plowed early in the fall but in some cases it is simply disked. Wheat is sowed with a drill. Oats are sometimes sowed in the fall, but generally in January or February. Commercial fertilizers are not used on this soil, and barnyard manure is seldom applied. Land of this type is held at \$15 to \$30 an acre.

Owing to the heavy nature of the Brackett silty clay loam, deep plowing and frequent thorough cultivation are necessary to prevent injury of crops by drought. Much of the plowing at present is shallow. The occasional application of barnyard manure or the plowing under of a green-manure crop would make the soil more friable and increase its productiveness. Owing to the rather low average yield of cotton, it would apparently be advisable to devote part of the acreage now used for this staple to subsistence and forage crops, and to raise more live stock.

*Brackett silty clay loam, eroded phase.*—Areas mapped as the eroded phase of the Brackett silty clay loam include several types of soils, with the Brackett silty clay loam apparently predominating. This type consists of a light-brown to yellowish silty clay loam which grades downward into a pale-yellowish or whitish, chalky material. Areas of stony soil of the Brackett, Windthorst, and Crawford series also occur, as well as of gravelly and clayey types of these series. The phase is mapped in some large areas in the rough valley section in the eastern part of the county, where the land is apparently too badly dissected for cultivation, except in irregularly distributed patches difficult of access. The best use of this phase as a whole seems to be for pasture.

SIMMONS FINE SANDY LOAM.

The Simmons fine sandy loam consists of a dark-brown to grayish-black fine sandy loam, underlain at a depth of 6 to 12 inches by a dark-brown to black clay becoming grayer in the lower depths. The lower subsoil is frequently or usually calcareous. In places colluvial wash from adjacent residual soils gives a brown or reddish-brown color to the surface material. In local depressions and basins the surface soil is quite dark in color and somewhat heavier than typical. These variations may be seen more or less distinctly in freshly cultivated fields.

This type is developed on high terraces or flat filled-in areas in the Palo Pinto, Colony, Leon, and Sabana Valleys, in the eastern and southeastern parts of the county. Smaller, scattered areas occur in the southern and southwestern sections.

The surface of the type is for the most part nearly level, with some local relief due to low knolls and slight depressions. Surface drainage in most places is adequate, but underdrainage is slow, owing to the denseness of the clay subsoil. The latter condition is on the whole advantageous, as it tends to conserve moisture. The type is not subject to overflow.

The Simmons fine sandy loam is locally an important type, and most of it is in cultivation. The principal crops are cotton, corn, milo, kafir, feterita, and Johnson grass. The minor crops include wheat, oats, fruits, and garden vegetables. The cereals and forage crops are used largely for the subsistence of dairy and beef cattle, hogs, and poultry.

The crop yields and methods of handling the soil are practically the same as on the Teller fine sandy loam, and the type can be improved in the same way as the latter soil.

In the following table are given the results of mechanical analyses of samples of the soil and subsoil of the Simmons fine sandy loam:

*Mechanical analyses of Simmons fine sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
444721.....	Soil.....	0.1	0.6	1.3	29.7	31.1	26.4	10.6
444722.....	Subsoil.....	.1	.2	.7	10.8	21.2	35.9	31.2

## SIMMONS CLAY LOAM.

The Simmons clay loam consists of a dark-brown to black clay loam, 5 to 10 inches deep, underlain by a similarly colored, compact clay which grades at a depth of about 3 feet into a somewhat gray-colored, calcareous clay. The substratum consists of a gray to dark-gray, calcareous clay. In places there may occur the lime-cemented hardpan, or "concrete" material, that is common in the Simmons soils elsewhere. In some places the surface material consists of a sandy clay loam or a shallow fine sandy loam which plows up as a sandy clay loam.

The Simmons clay loam occurs on high terraces or filled areas along Colony Creek and the Leon and Sabana Rivers. In the south central part of the county along the Sabana River the type occupies some large areas.

The surface is for the most part rather level, but in places is marked by low hummocks and shallow depressions. In the depressions the soil is black, while on the hummocks it is browner and more calcareous.

Surface drainage is in general adequate. Underdrainage is retarded by the clay subsoil, which renders the type retentive of moisture.

Possibly 60 per cent or more of this soil is in cultivation. The remainder supports a tree growth, consisting largely of mesquite, with some live oak, and an undergrowth of brush, shrubs, and grasses. The latter flourish in favorable years and afford pasturage practically the year round. The principal crops are cotton, milo, kafir, feterita, sorghum, and Johnson grass. Wheat, oats, fruits, and vegetables are grown to some extent. The yield of cotton ranges from one-fourth to three-fourths bale per acre, depending on the rainfall and other conditions. Corn yields 10 to 25 bushels an acre, grain sorghums 10 to 30 bushels, wheat 5 to 20 bushels, and oats 10 to 30 bushels. Johnson grass yields 1 to 3 tons of hay per acre.

Dairy cattle, beef cattle, hogs, and poultry are raised in connection with the growing of general farm crops, the cereals and forage produced being largely used in support of the animal industries.

The cropping practice and the methods of soil preparation are practically the same on this type as on the Teller fine sandy loam.

The ruling prices of this land range between \$15 and \$30 an acre. More care and labor are required to maintain this soil in good tilth than in the case of the sandy types. The plowing is usually shallow. It would be beneficial to increase the depth of plowing gradually until a depth of 6 to 9 inches is attained. The addition of organic matter through the application of rotted manure or the plowing under of green-manure crops would tend to improve the tilth and producing power of the soil.

The results of mechanical analyses of samples of the soil and subsoil of the Simmons clay loam are given in the following table:

*Mechanical analyses of Simmons clay loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
444715.....	Soil.....	0.2	1.2	3.4	26.4	17.5	28.6	22.6
444716.....	Subsoil.....	.2	1.2	2.6	22.6	15.4	33.1	25.1

TELLER FINE SANDY LOAM.

The Teller fine sandy loam consists of a brown to reddish-brown fine sandy loam, 8 to 12 inches deep, underlain by a subsoil of pale red to red, rather compact clay, extending to a depth of 3 feet. In places the surface soil is a loamy fine sand. Occasionally there is an admixture of small quartz, chert, and dark-colored pebbles in both soil and subsoil. In some areas the upper subsoil is red or yellowish red, and the lower lighter red, pinkish or salmon colored, and calcareous. Where the subsoil is of a nearly uniform red color throughout, the material seems for the most part to be noncalcareous.

This type occurs on stream terraces in or adjacent to the Colony, Léon, and Sabana Valleys. It is developed in detached and rather irregularly distributed areas. In general the surface is comparatively level, though there are some low knolls and gentle slopes.

Surface drainage over the type is adequate. The clay subsoil is retentive of moisture and the type ranks with the other sandy soils of the county in drought resistance.

The Teller fine sandy loam is locally an important type, and it is practically all under cultivation. The principal crops are cotton, corn, milo, kafir, feterita, and Johnson grass. Wheat, oats, fruits, garden vegetables, and peanuts are grown to some extent. Cotton yields from one-fourth to three-fourths bale per acre, depending on the rainfall and other conditions. Corn yields 10 to 25 bushels per acre, grain sorghums 10 to 30 bushels, wheat 5 to 20 bushels, oats 10 to 30 bushels, and Johnson-grass hay 1 to 3 tons. Peanuts and millet do well.

Raising dairy and beef cattle, hogs, and poultry is carried on in connection with general farming. The cereal and forage crops grown are used largely to support stock.

In growing summer crops, plowing is done usually during January and February. Turning plows, middle busters, disks, and harrows are used in preparing the seed bed. Planting varies with the season, but ordinarily takes place in March or April. Cotton, corn, grain sorghums, and peanuts are usually planted with improved planters which place the seed in furrows of the desired depth. Cultivation is usually given at frequent intervals and the soil is gradually thrown into the listed furrows, leaving the surface level. For winter crops the soil is usually plowed early in the fall and harrowed, though in some instances it is simply disked. Wheat is sown with a drill, usually in October. Oats land is sometimes seeded in the fall, but this crop is mainly sown in January or February. No commercial fertilizers are used on this soil, and barnyard manure is seldom applied.

The present selling price of land of this type of soil varies from about \$20 to \$35 or more an acre, depending on the improvements and location.

In general, the Teller fine sandy loam is deficient in organic matter. In the absence of an adequate supply of barnyard manure it would be advisable to plow under occasionally some green vegetation. The addition of organic matter would not only retard drifting of the soil but would materially increase its productiveness.

#### FRIO FINE SANDY LOAM.

The Frio fine sandy loam consists of a dark-brown fine sandy loam, 6 to 12 inches deep, underlain by a dark-brown, compact silty clay extending to a depth of about 3 feet. The lower subsoil is nearly always more or less calcareous. The substratum consists of a grayish, calcareous clay.

In places fields are spotted with patches of brownish and very dark colored material. The subsoil also varies, ranging from a fine sandy loam to a fine sandy clay in texture and from the typical brown to black in color. There may be little or no calcareous reaction within the 3-foot section. Occasionally in depressions and flat areas there is some whitish efflorescence of alkali salts, but such conditions seem not to be extensive.

This type occurs almost exclusively as first-bottom land along Palo Pinto Creek, in the eastern part of the county. A few small areas are mapped along other streams. The type is also encountered in many patches too small to separate from the surrounding predominant, heavier textured soils.

The surface is characteristically level, with some hummocks, swells, and shallow depressions. When the streams are at normal levels the surface and subsurface drainage is in most places adequate, and parts of the type may even be droughty. Following heavy or prolonged rainfall, overflows cause more or less serious damage to crops. These may occur at any time of the year.

Except for the occasional overflows, this type is a desirable soil. Possibly less than one-half of the type is in cultivation, the remainder supporting a growth of mesquite and along and near the stream courses pecan trees. The principal crops are cotton, corn, grain sorghums, and Johnson grass. Wheat and oats are crops of minor importance. Cotton yields from one-fourth to 1 bale per acre, corn 10 to 25 bushels per acre, and grain sorghums 10 to 30 bushels. Johnson grass yields 1 to 3 tons of hay per acre. Crop yields vary with the rainfall and flood conditions. Some dairy and beef cattle and hogs are raised in connection with general farming. The native pasture is utilized extensively in support of live stock, and the field crops produced are used to a large extent as supplementary feed.

Land of this type is valued at \$5 to \$25 an acre, depending on the liability to overflow, the state of improvement, and the nearness to towns and lines of transportation.

Owing to the uncertainties surrounding the production of cultivated crops over a considerable part of this type, it can probably be used best in the production of forage, hay, and pasture crops. The native growth of pecan suggests the possibilities of developing orchards of this nut. Overflows are usually of short duration and apparently do not injure the trees, and even when the streams become dry moisture seems to remain in the substratum within reach of the root systems of the trees. In some years the production from the native trees is large.

#### FRIO SILTY CLAY LOAM.

The Frio silty clay loam consists of a dark-brown to grayish-black silty clay loam, 6 to 8 inches deep, underlain by a medium-brown to dark-brown, compact silty clay. This usually becomes grayish brown to dark grayish in color at a depth of about 3 feet. The lower subsoil is nearly always more or less calcareous, as is also the grayish clay substratum beneath.

In places this soil shows the same patchy conditions as noted in the type last described. There are also other local variations, mainly in texture, the surface soil ranging from a fine sandy loam or silty loam to a clay. In some depressions there are indications of alkali, but these are not extensive.

The Frio silty clay loam occurs as first-bottom land along all the streams of the county. In breadth the individual areas range from

almost negligible strips to embaymentlike bottoms a mile or more wide. Usually the wider areas are developed along the lower courses of the streams.

The surface of the type is characteristically level, but low hummocks or swells and slight depressions or flats occur in places. Between periods of overflow the drainage is good. Overflows may occur at any season of the year, depending on the rainfall conditions, and sometimes damage crops.

Except for liability to occasional overflows, this is a desirable soil. Possibly one-half of its total area is in cultivation, the remainder supporting the native timber growth of mesquite and other trees, with pecan near the stream courses.

Cotton, corn, and grain sorghums are the principal crops. Johnson grass is of considerable importance. Wheat, oats, and other crops are grown to some extent. Cotton yields from one-fourth to one bale an acre, corn 10 to 25 bushels, grain sorghums 10 to 30 bushels, and Johnson-grass hay 1 to 3 tons. Some live stock is raised. The type affords good pasturage in seasons of sufficient rainfall.

Land of the Frio silty clay loam type can be bought for \$5 to \$25 an acre, depending on the liability to overflows, the state of improvement, and the location.

On account of the uncertainties surrounding the production of cultivated crops, owing to drought and danger from overflows, this type is apparently better adapted to the production of forage and hay crops and for use as pasture land than to growing cotton or the cereals. The growth of wild pecan trees indicates that the utilization of much of the type for pecan culture might be feasible.

#### ROUGH STONY LAND.

Rough stony land includes steep, stony areas with little soil material. The land is nonarable and ranks lower for pasture purposes than the stony soils classed with established series. Various kinds of oak, mesquite, and thorny brush are found on this type of land. Pasturage is more variable and uncertain than on other types of the county. The rock fragments and outcrops consist of sandstone, conglomerate, and limestone. Rough stony land is quite extensive, large bodies occurring in the northern third of the county.

#### SUMMARY.

Eastland County lies in the central part of Texas. It covers an area of 930 square miles, or 595,200 acres. The northern third of the county includes rather deeply cut and steep-sided valleys with more or less rough and hilly intervening upland areas. Over the remainder of the county the valleys are less deeply carved and are bordered by more gentle slopes, and the interstream uplands include

more extensive areas of level to gently sloping and rolling land. Second bottoms or terraces occur inextensively in more or less detached bodies along the principal streams. Overflowed first-bottom lands are more extensively developed, but occur in strips of very irregular width.

The greater part of the upland apparently lies between elevations of 1,500 and 1,700 feet above sea level. The extreme range in elevation is about 500 feet or from 1,250 to 1,750 feet above sea level.

Battle Creek, Sandy Creek, and Palo Pinto Creek drain the northern third of the county, and Sabana River, Colony Creek, and Leon River the remainder. All the streams of the county are small and largely intermittent.

Eastland County had a population in 1910 of 23,421, or an average of 25.3 persons per square mile. Possibly one-third or more of the inhabitants live on farms or in the small rural settlements. Eastland, population 855, is the county seat.

The county has fairly good railway facilities. There are a few well-built country roads connecting the larger towns, but the less important roads are not so well improved. Telephone service is in quite general use in the rural communities.

The mean annual rainfall, as recorded at the Weather Bureau station at Dublin, Erath County, averages 27.29 inches. The precipitation is irregular, ranging from 13.69 inches for the driest year to 39.50 for the wettest year. Long dry periods occasionally occur as well as short periods of hot, drying winds in May and June. With abundant rains crops usually give good yields. The winters are mild, and certain crops can be grown the year round. As a rule, however, only one major crop is grown on the same land in one year, the soil being allowed to store moisture during the intervening period for the next annual crop.

The summer crops most extensively grown are cotton, grain sorghums, corn, peanuts, and Johnson grass. Winter crops, consisting mainly of wheat and oats, are grown to a lesser extent. Sorghum for sirup, millet, fruit, and garden vegetables are less important crops. Yields in all classes are largely dependent on seasonable rains. Ordinarily native grazing is available throughout most of the year and contributes much to the support of the live-stock industry.

Cotton is by far the most important product of the county, followed by live-stock products, hay and forage crops, and cereals.

The soils of Eastland County are classed in four groups, viz, those residual from sandstone, shale, and conglomerate, classed in the Windthorst and Ninarod series; those residual from limestone, classed in the Crawford and Brackett series; those derived apparently from outwash-plain or valley-filling material, classed in the



Simmons and Teller series; and those of recent-alluvial origin, classed in the Frio series.

The Windthorst series is represented by four types. These on the whole are desirable soils, the stony type being used for pastures and the others for growing various crops.

The Nimrod fine sand is a fairly well drained, desirable agricultural soil. It is mainly in cultivation to general farm crops. In recent years considerable attention has been given to peanut culture.

The Crawford stony clay is best adapted to use as pasture land, but the clay loam gives average yields of the common general farm crops.

The Brackett stony loam gives best results as grazing land, but the fine sandy loam and silty clay loam rank among the better farming soils in the county.

The Simmons soils are desirable agricultural types, developed in terrace situations.

Practically the entire area of the Teller fine sandy loam, also a stream-terrace soil, is farmed.

The Frio fine sandy loam and silty clay loam are first-bottom soils, subject to overflow. Otherwise they are well drained and productive. These soils are valued for their growth of wild pecan trees.

Rough stony land includes steep and stony nonarable areas.

[PUBLIC RESOLUTION—No. 9.]

JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

*Resolved by the Senate and House of Representatives of the United States of America in Congress assembled,* That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]

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